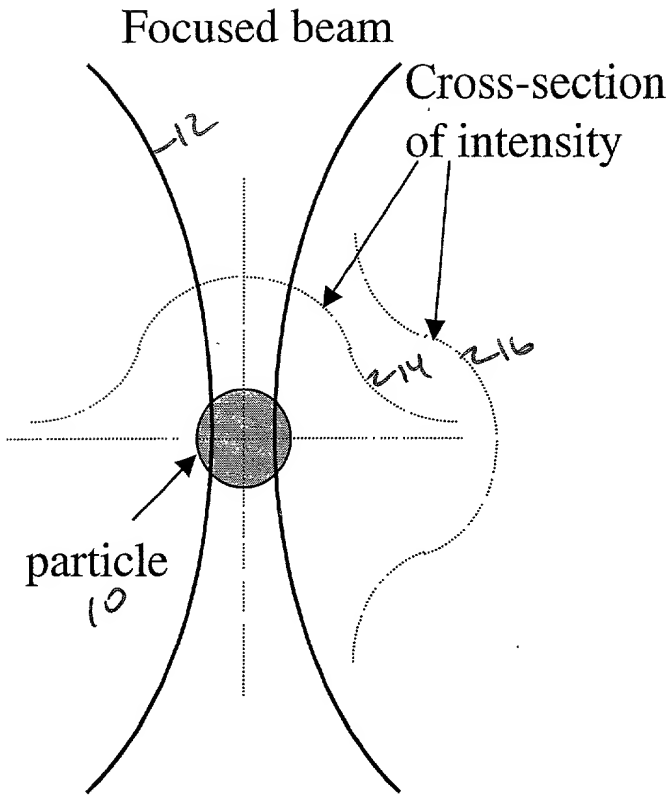


$$F_{\nabla} = 2\pi \cdot r^3 \frac{\sqrt{\varepsilon_B}}{c}\left(\frac{\varepsilon - \varepsilon_B}{\varepsilon + 2\varepsilon_B}\right)(\nabla \cdot I)$$

F_{∇} = optical force on particle towards higher intensity

r = radius of particle

ε_B = dielectric constant of background medium

ε = dielectric constant of particle

I = light intensity (W/cm^2)

∇ = spatial derivative

Fig. 1

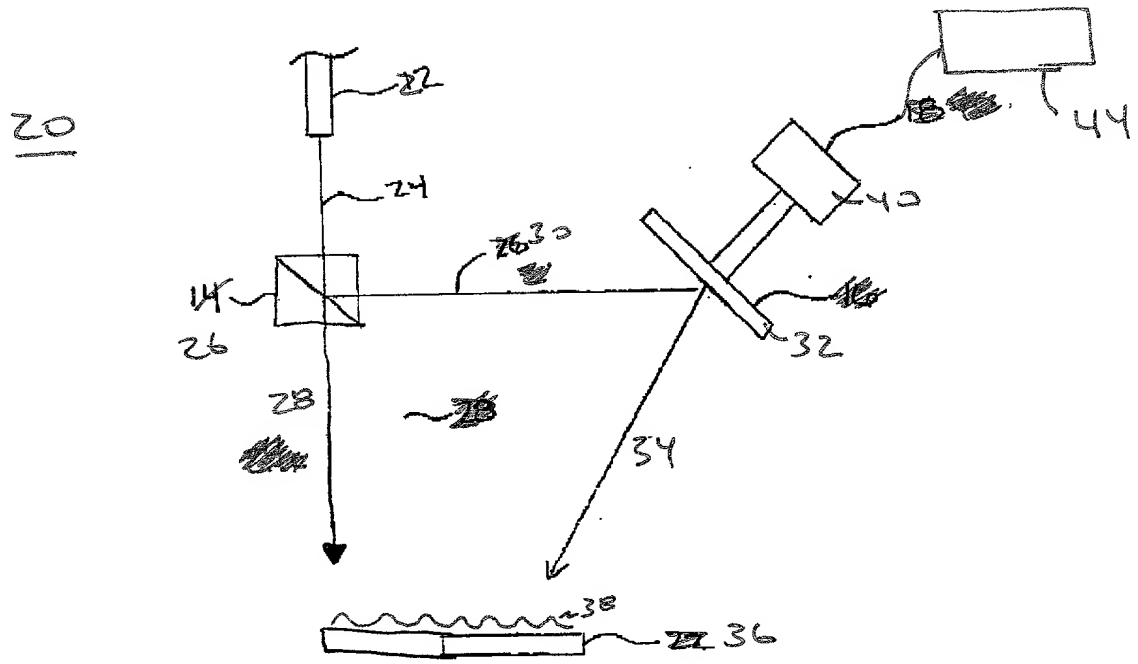


Fig. 2

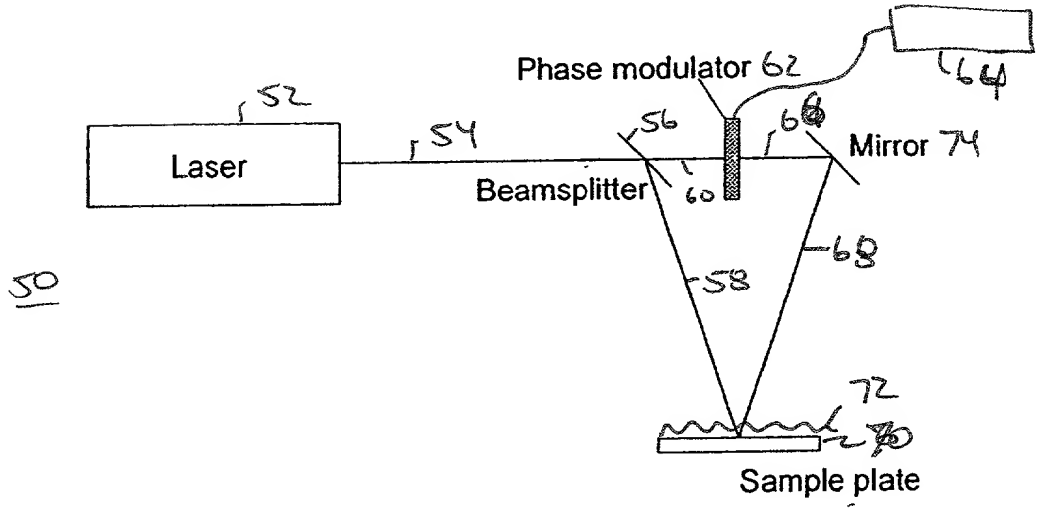


Fig. 3

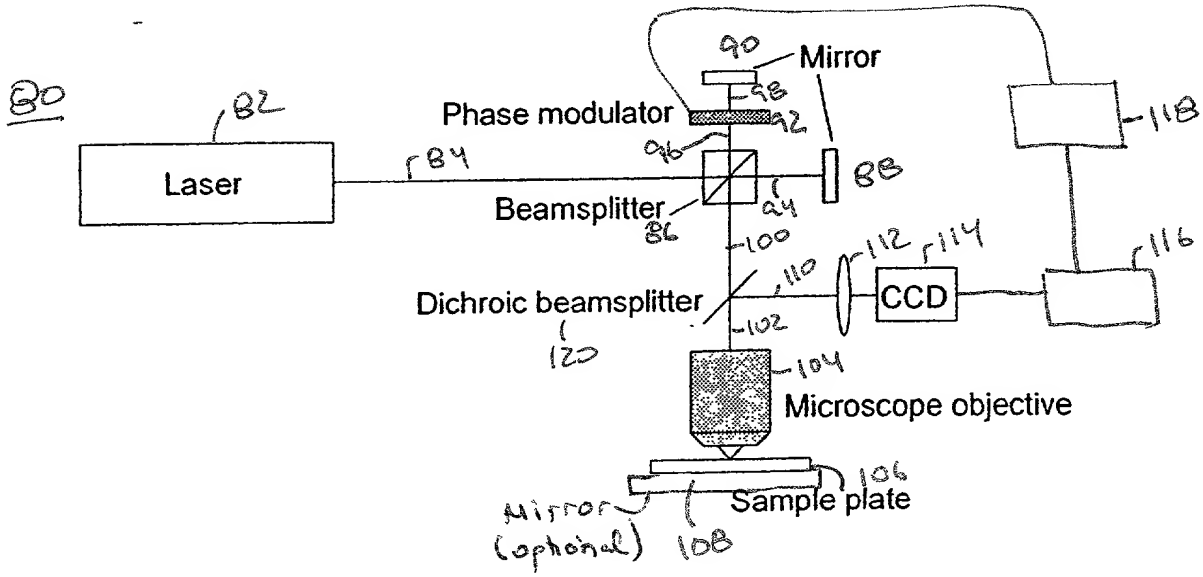


Fig. 4

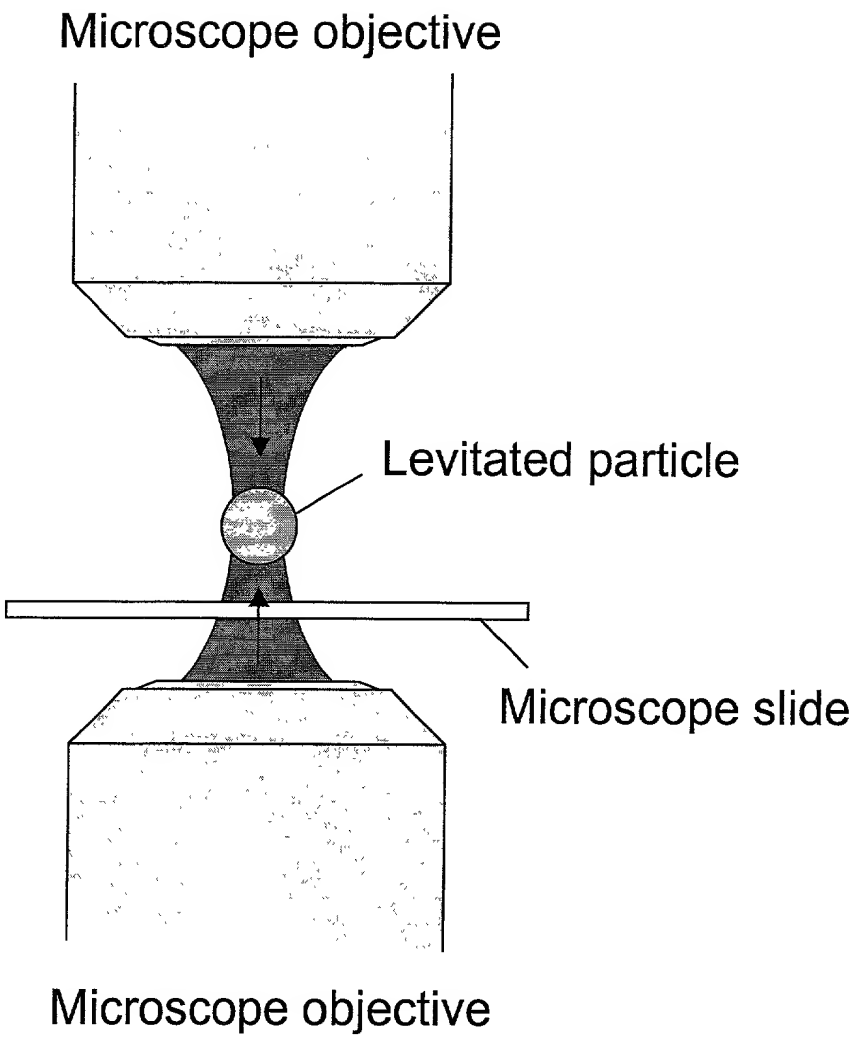

Microscope objective
Levitated particle
Microscope slide
Microscope objective

Fig. 4A

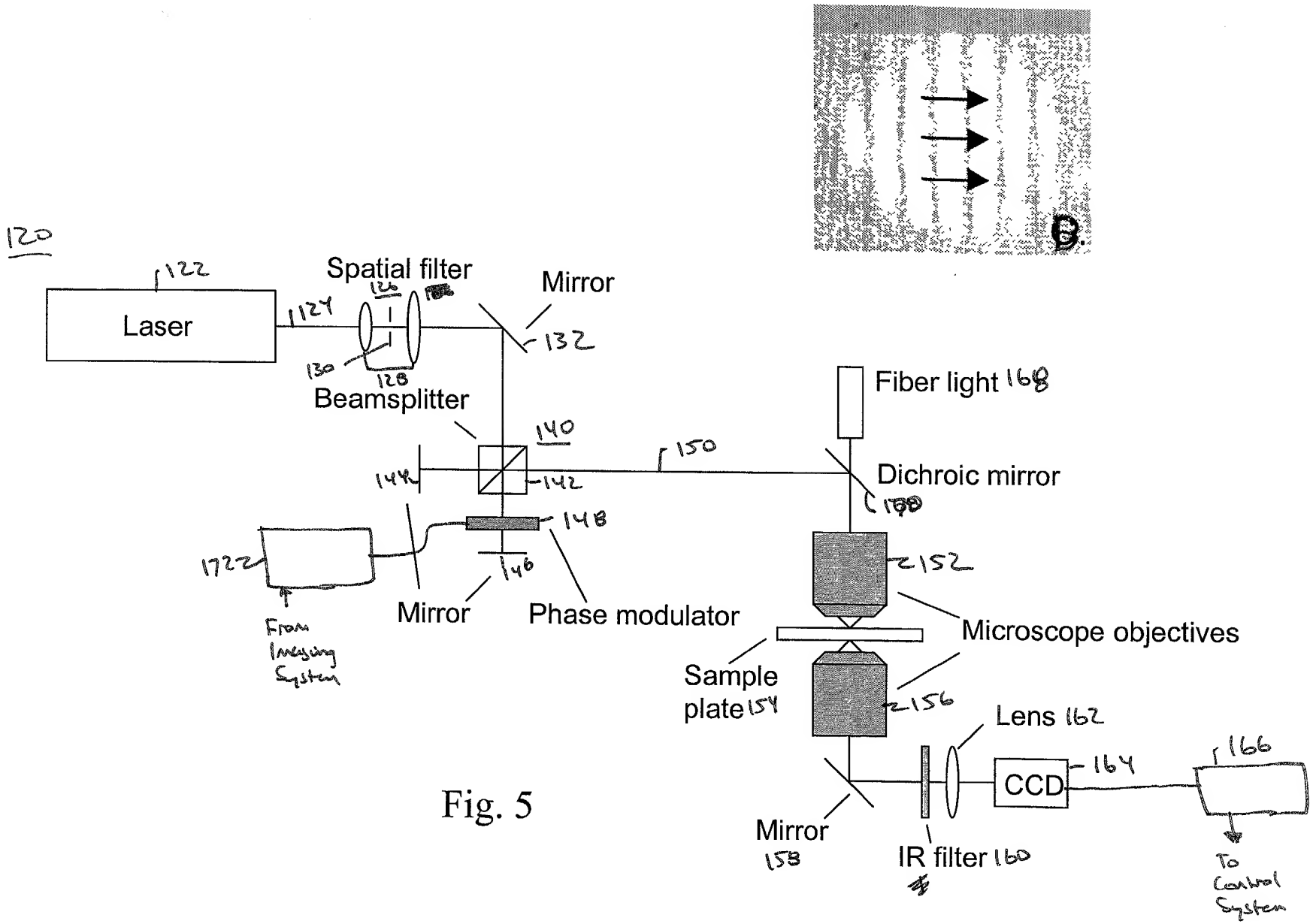

B.
120
122
Laser
124
Spatial filter
126
128
130
Beamsplitter
Mirror
132
140
142
144
146
148
150
1722
From Imaging System
Mirror
Phase modulator
Fiber light 168
Dichroic mirror
152
Microscope objectives
Sample plate 154
156
Lens 162
CCD
164
166
Mirror 158
IR filter 160
To Control System

Fig. 5

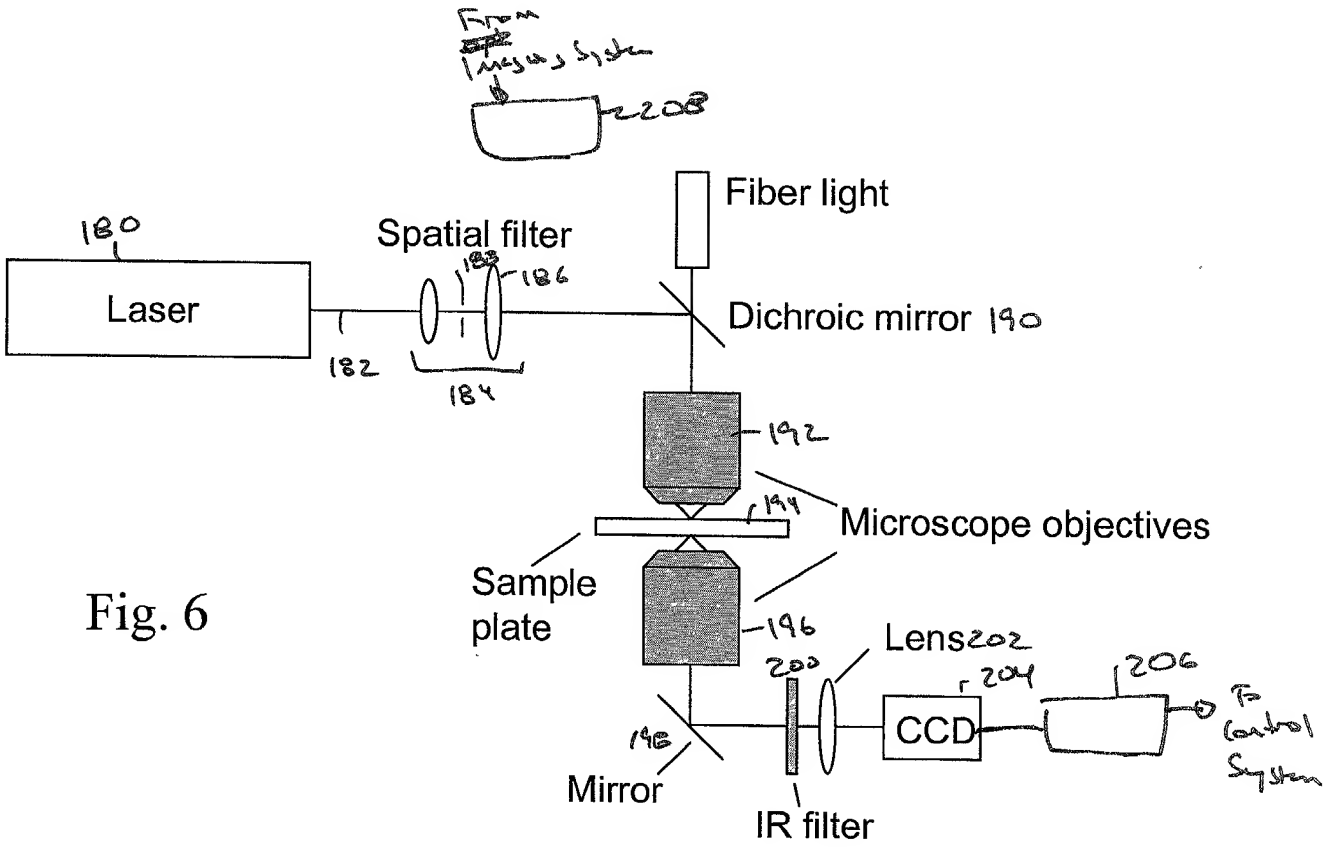


Fig. 6

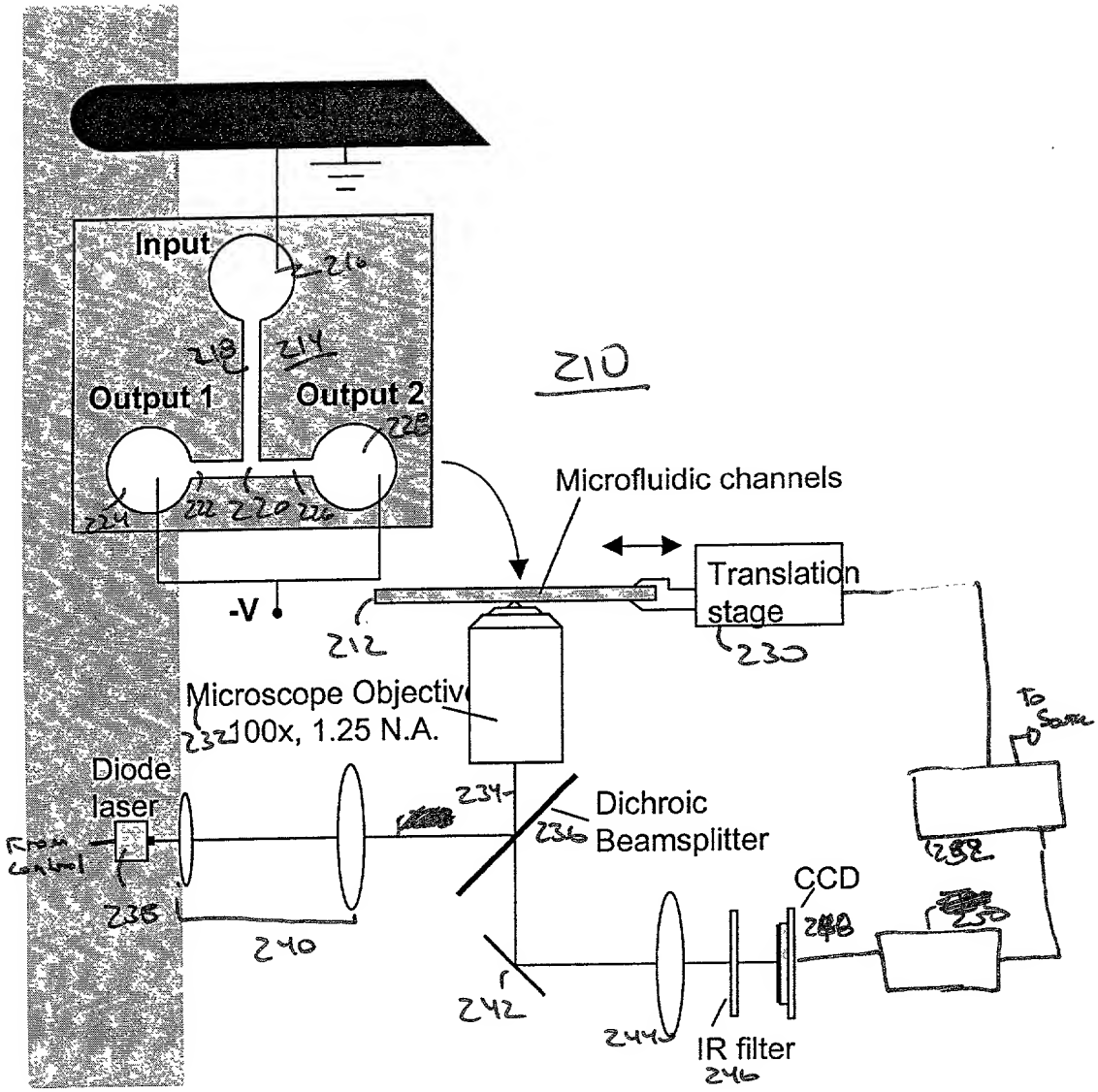

Input
Output 1
Output 2
210
Microfluidic channels
Translation stage
-V
Microscope Objective
100x, 1.25 N.A.
Diode laser
Dichroic Beamsplitter
CCD
IR filter

Fig. 7

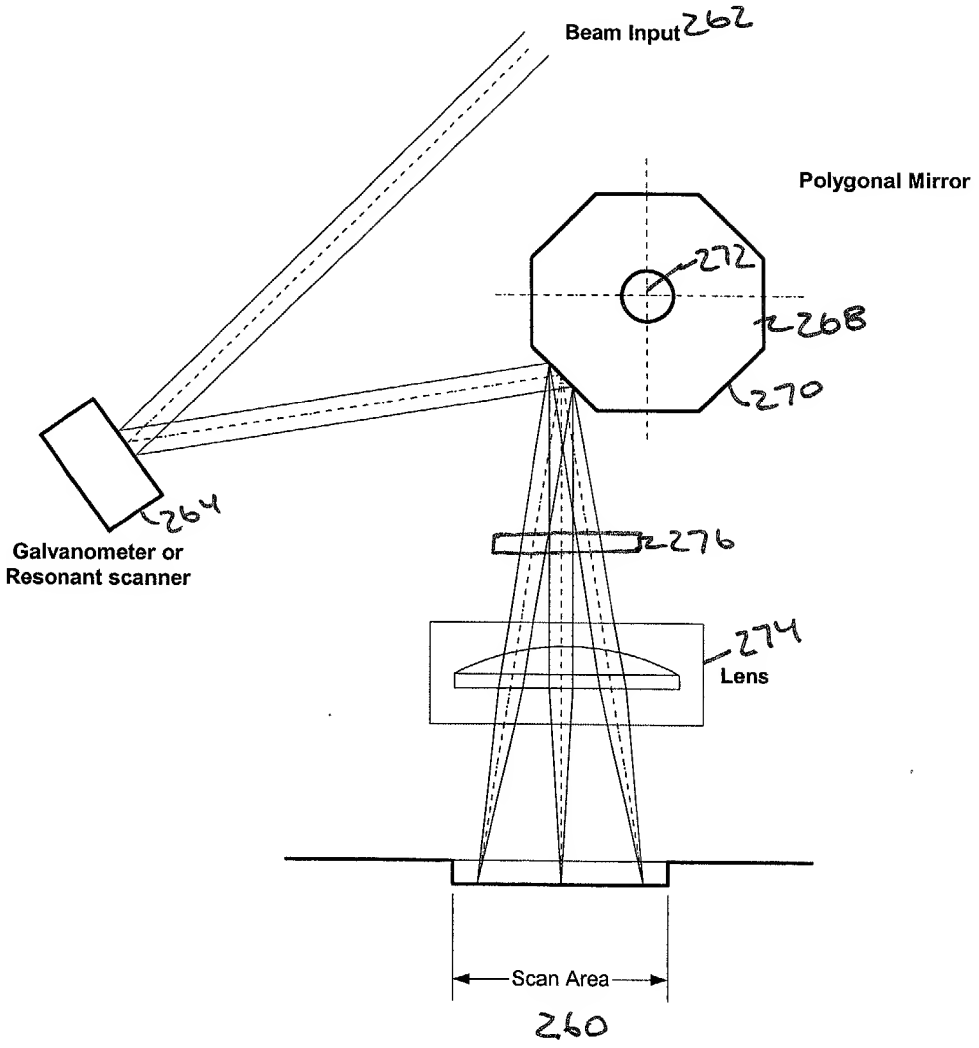


Fig. 8

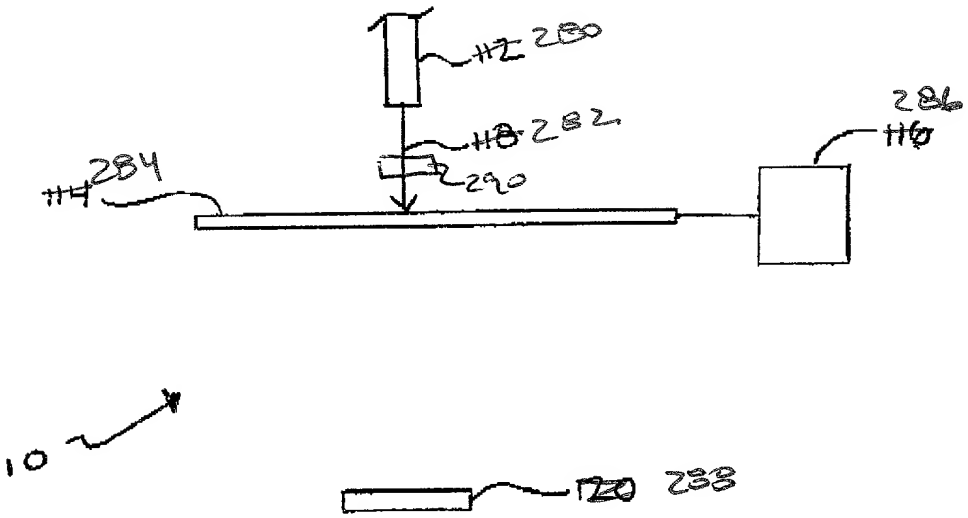

112 280
118 282
290
284
114
286
116
10
120 288

Fig. 9A

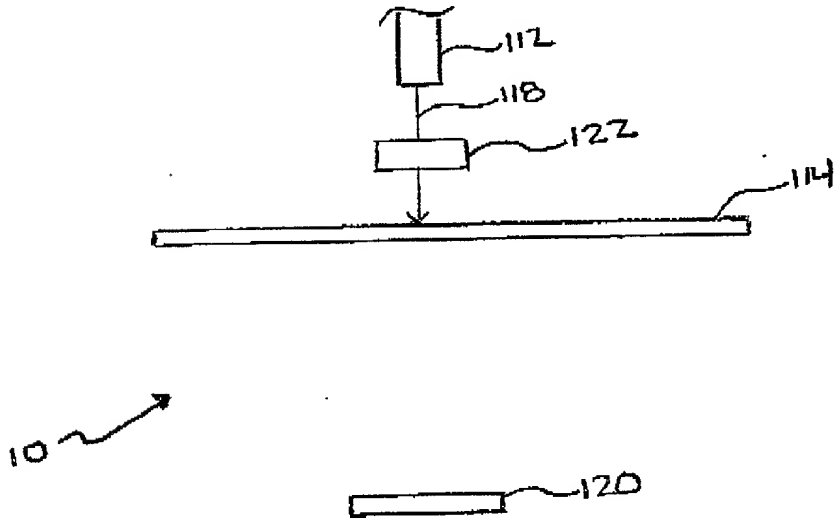

112
118
122
114
10
120

Fig. 9B

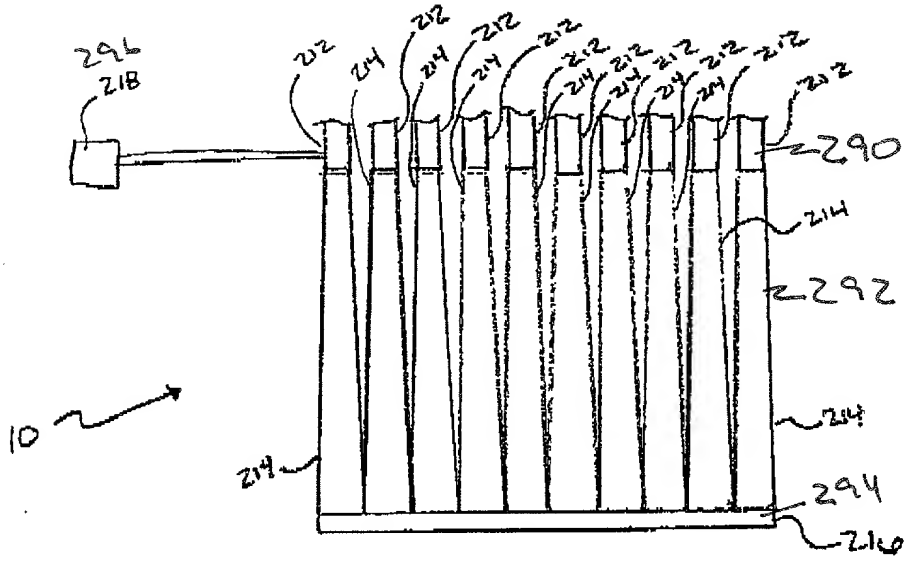


Fig. 10

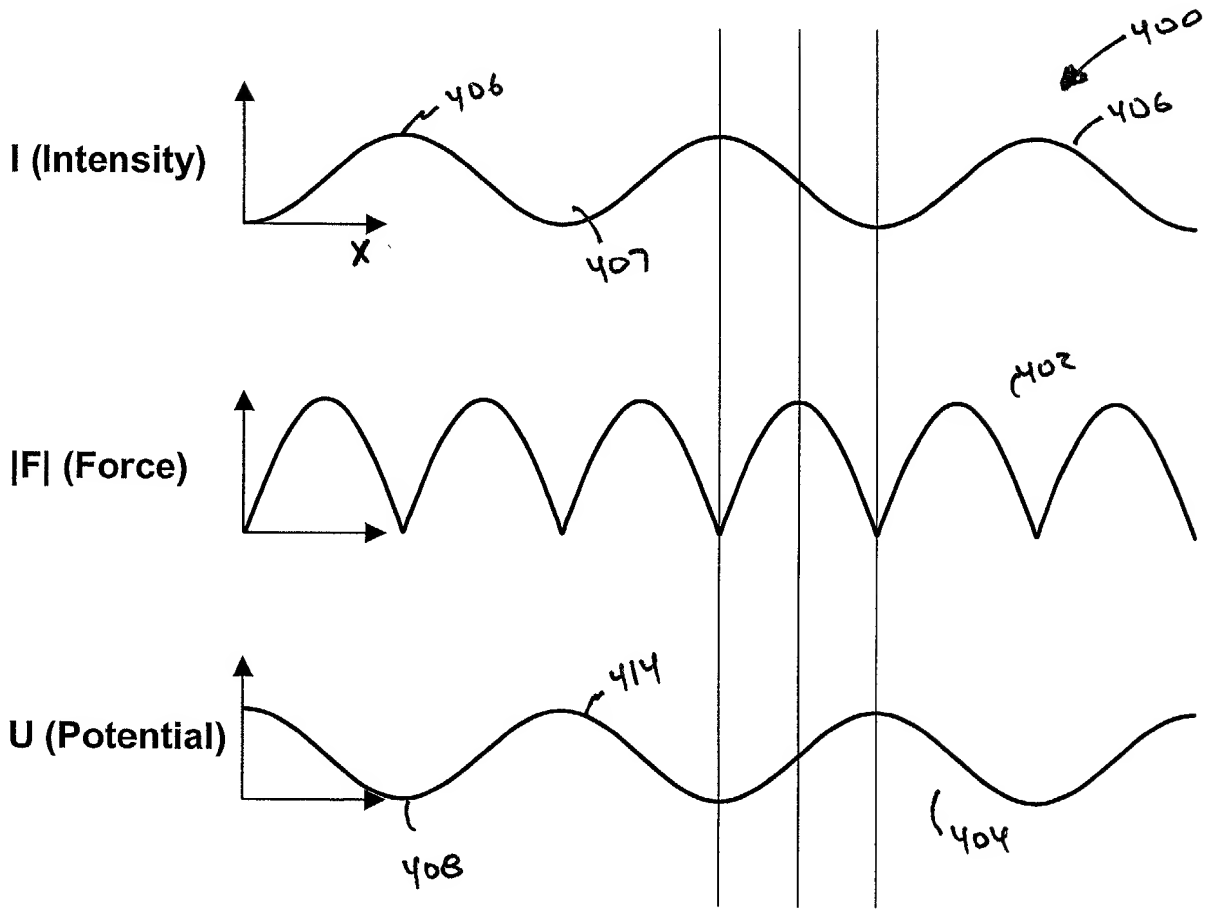


Fig. 11A

Fig. 11B

Fig. 11C

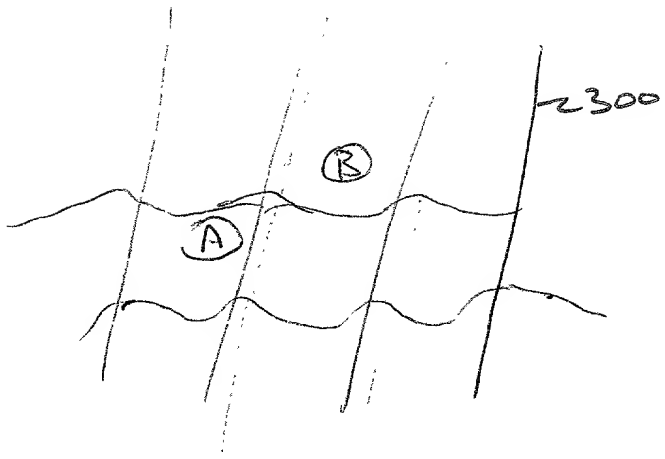


Fig. 12A

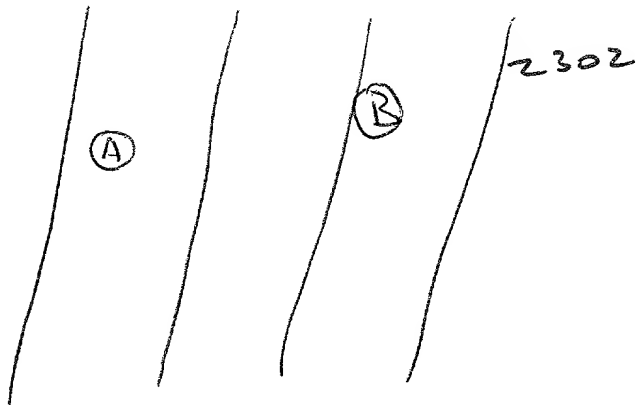


Fig. 12B

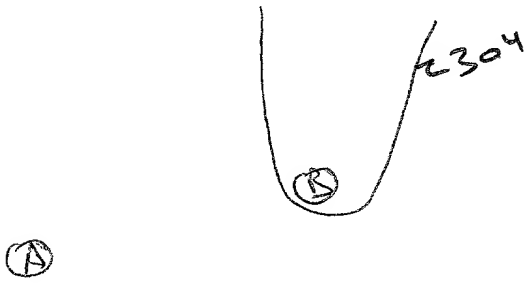


Fig. 12C

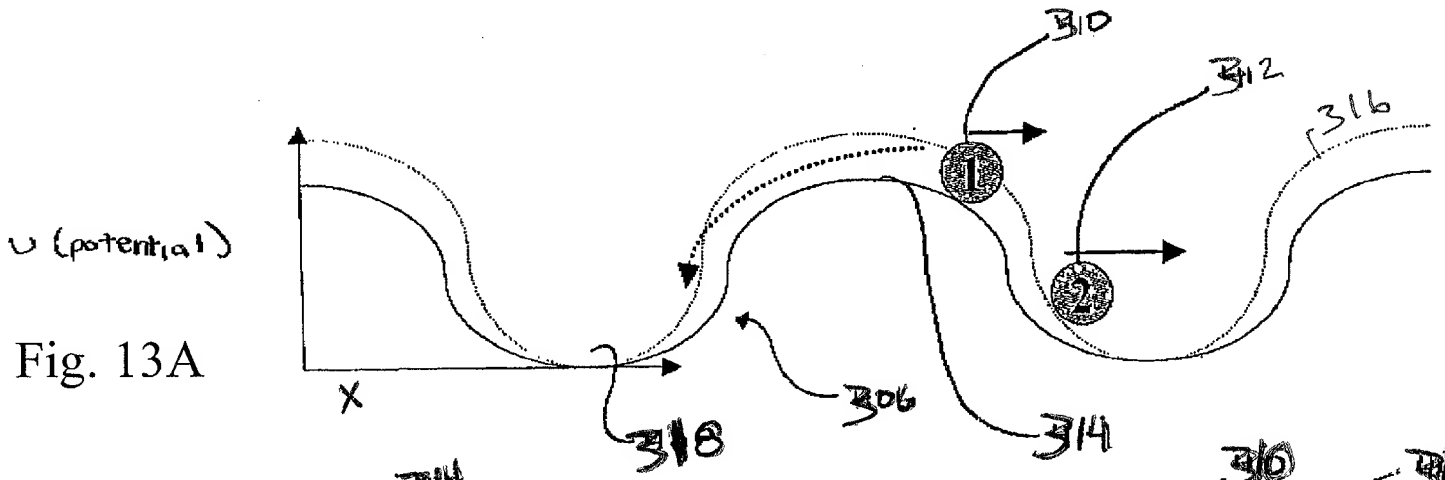


Fig. 13A

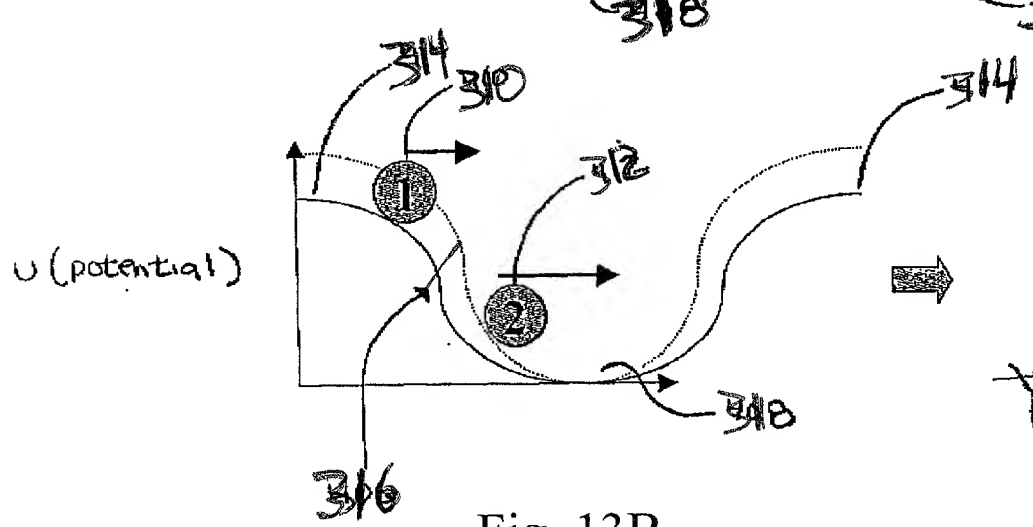


Fig. 13B

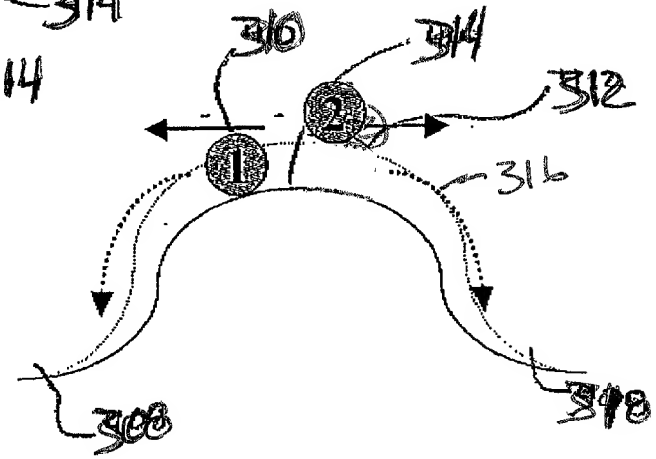


Fig. 13C

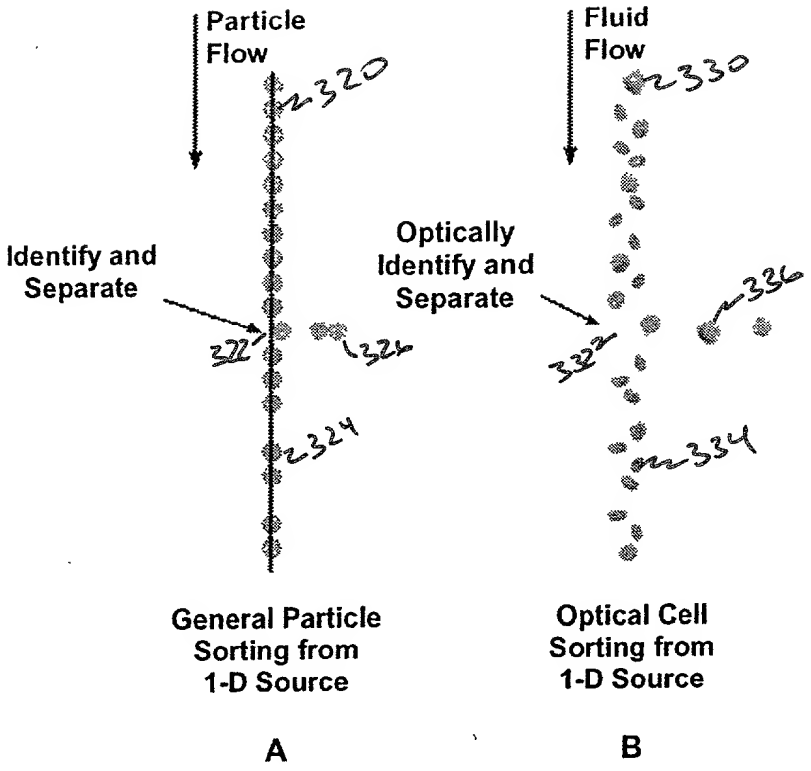


Fig. 14A

Fig. 14B

Sorting in a T-channel

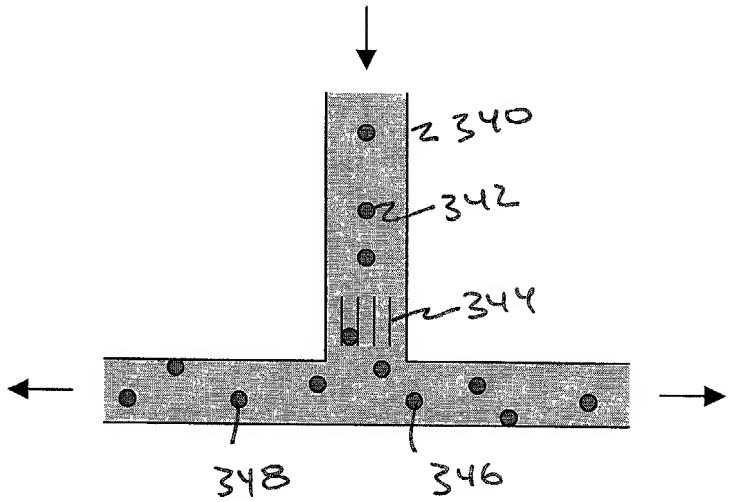


Fig. 15

Sorting in an H-channel

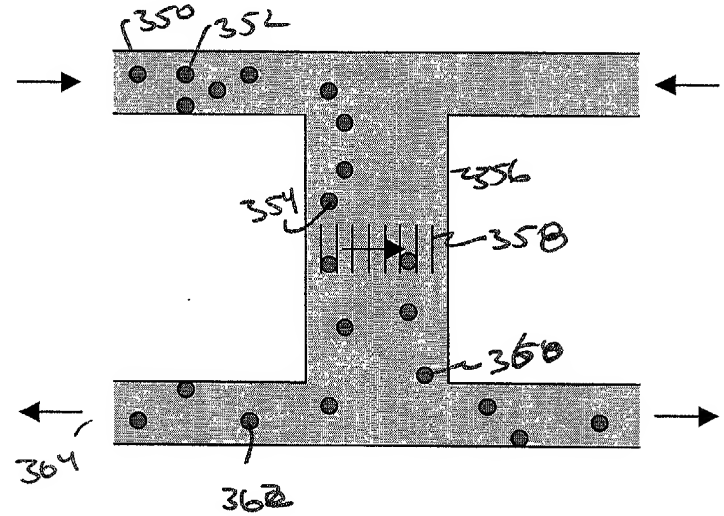


Fig. 16

Y-Channel

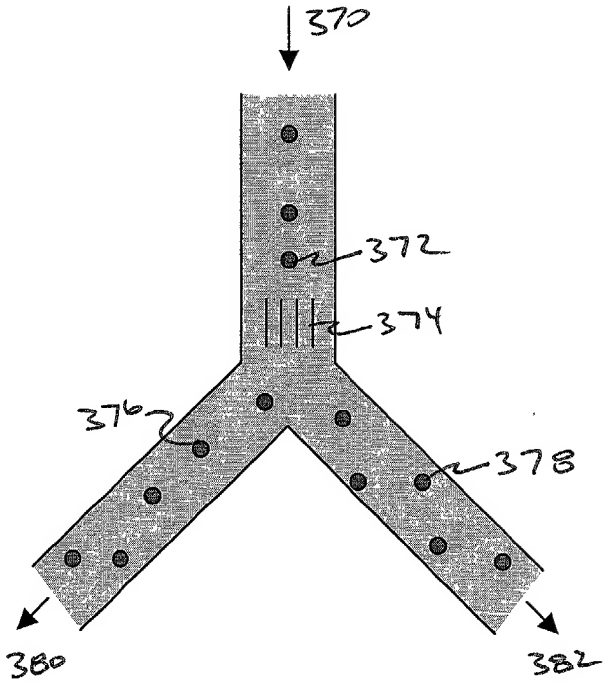


Fig. 17

X-Channel

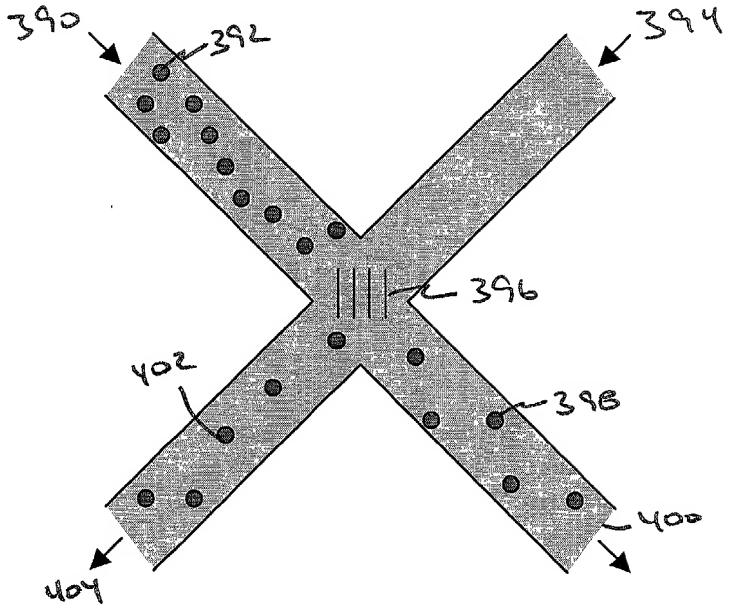


Fig. 18

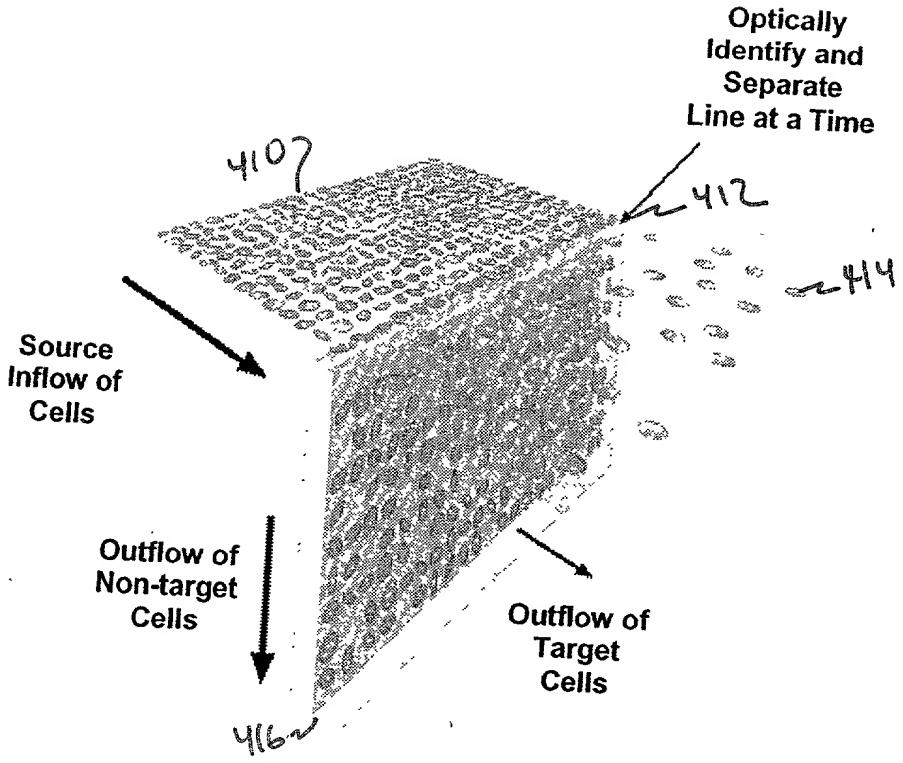

Optically Identify and Separate Line at a Time
410
412
414
Source Inflow of Cells
Outflow of Non-target Cells
Outflow of Target Cells
416

Fig. 19

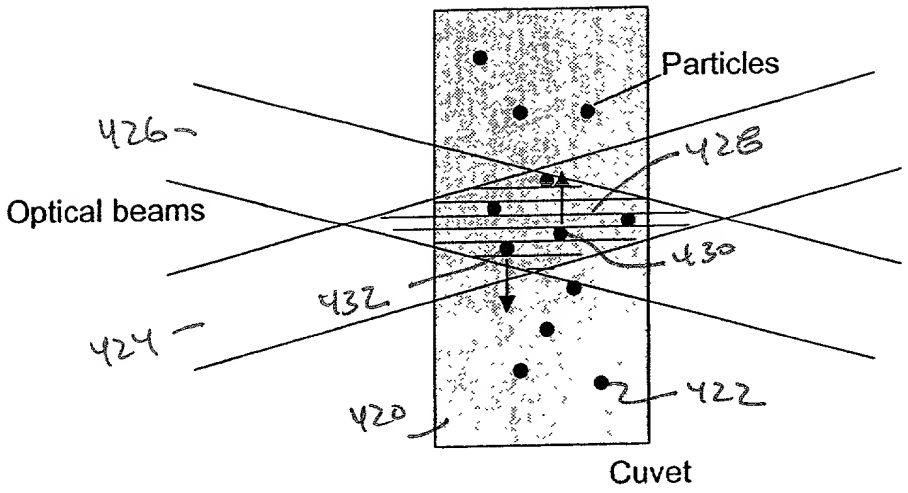

Particles
426
428
Optical beams
430
432
424
422
420
Cuvet

Fig. 20

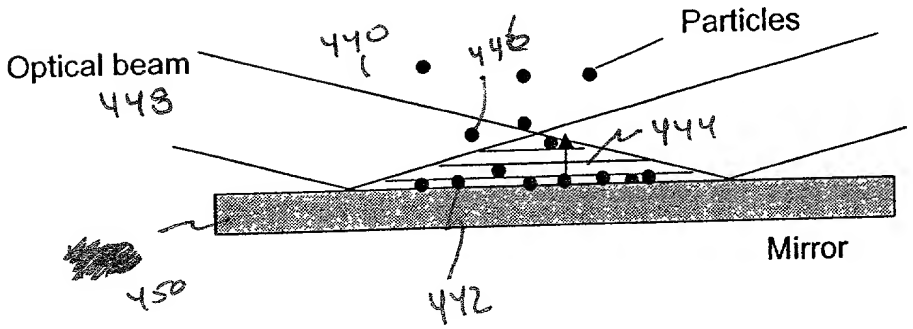

Particles
440
446
Optical beam
448
444
Mirror
450
442

Fig. 21

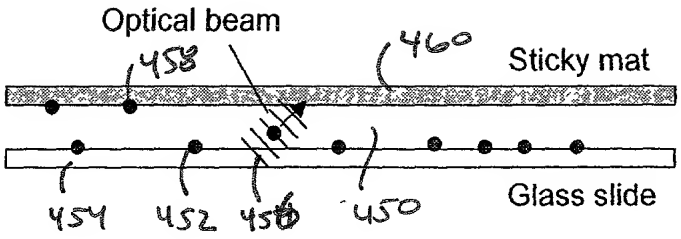
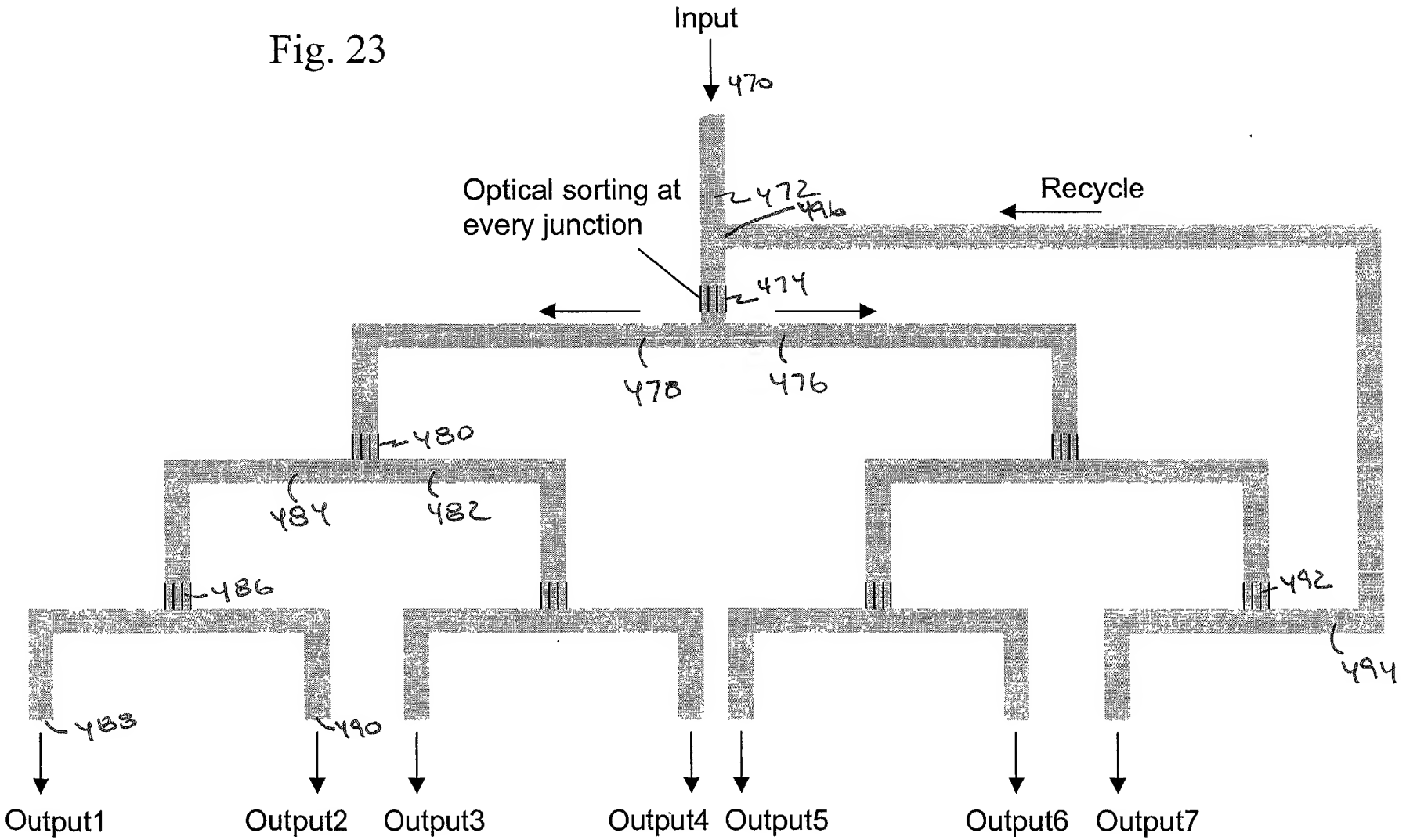


Fig. 22

Fig. 23


Input
470
Optical sorting at every junction
472
496
Recycle
474
478
476
480
484
482
486
492
494
488
490
Output1
Output2
Output3
Output4
Output5
Output6
Output7

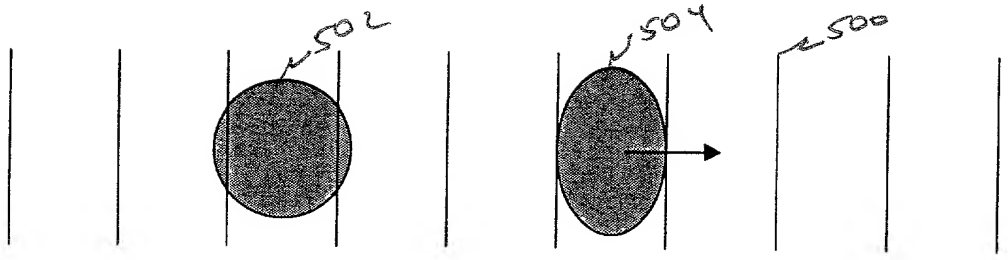


Fig. 24

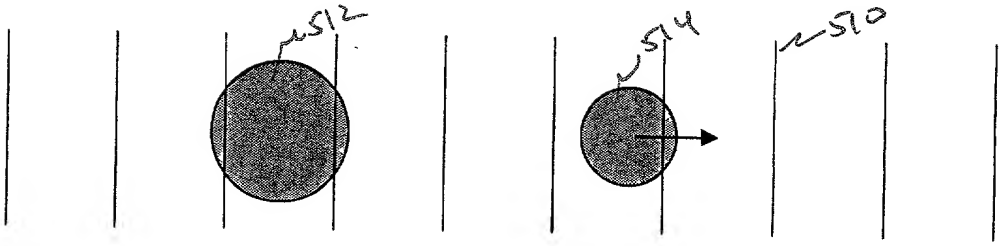
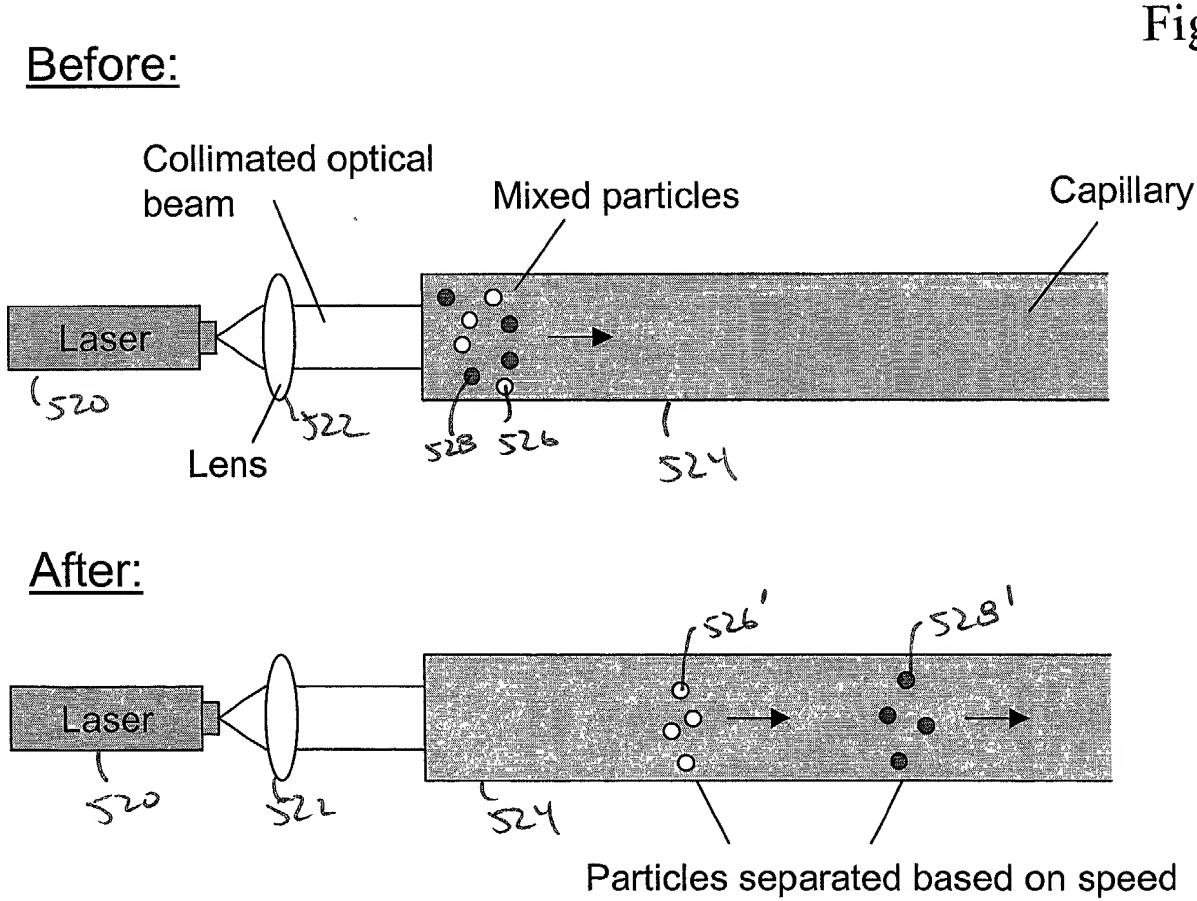


Fig. 25

Scatter Force Separation

Fig. 26



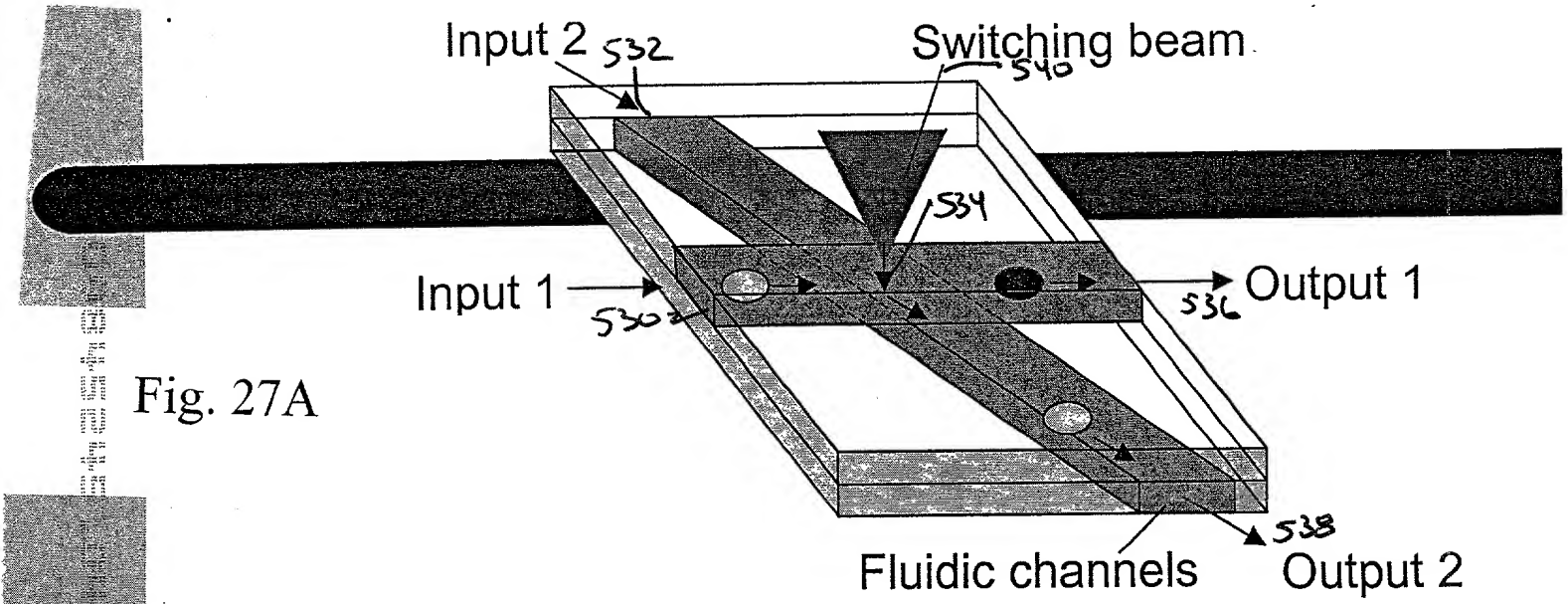


Fig. 27A

View from the side:

Optical beam **off**:

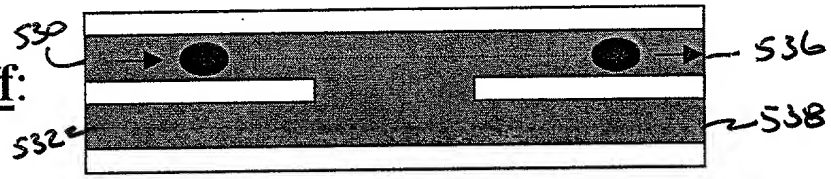


Fig. 27B

Optical beam **on**:

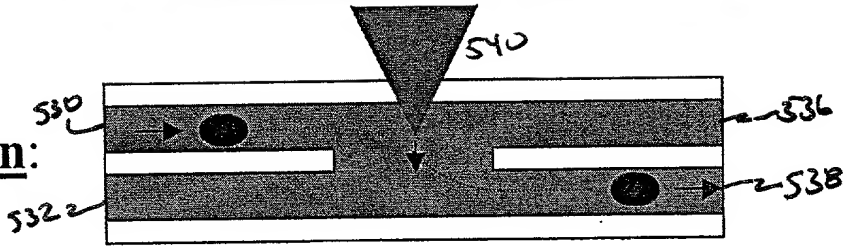


Fig. 27C

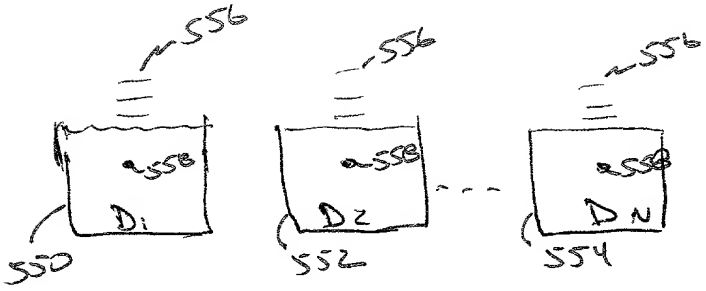

556
556
556
558
558
558
D1
D2
DN
550
552
554

Fig. 28

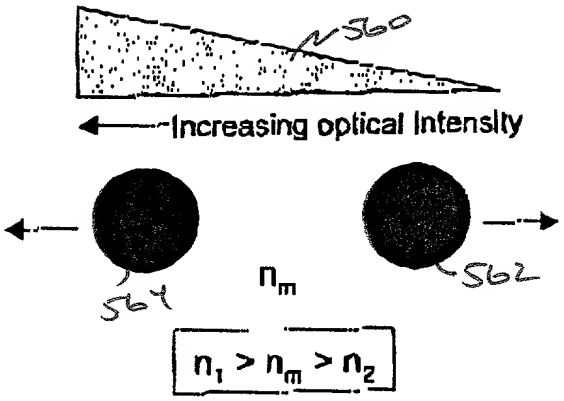

560
Increasing optical Intensity
564
562
n_m
$n_1 > n_m > n_2$

Fig. 29

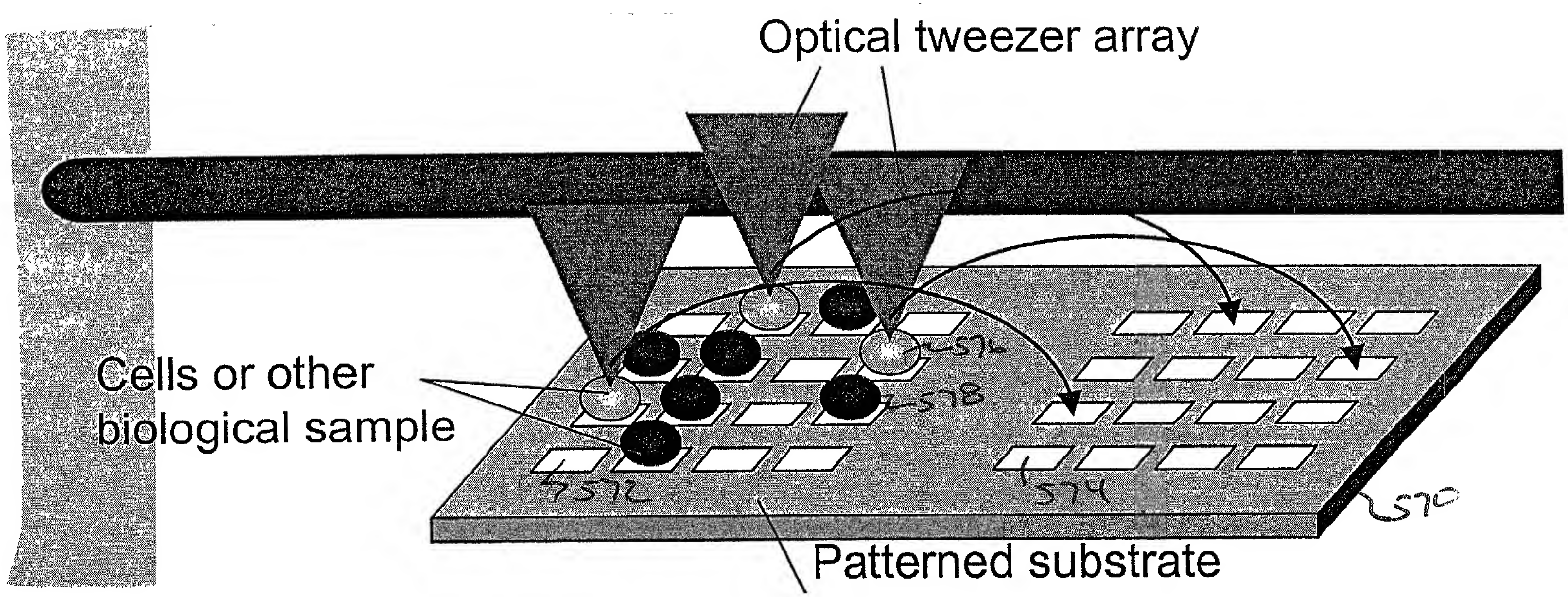

Optical tweezer array
Cells or other biological sample
576
578
572
574
570
Patterned substrate

Fig. 30

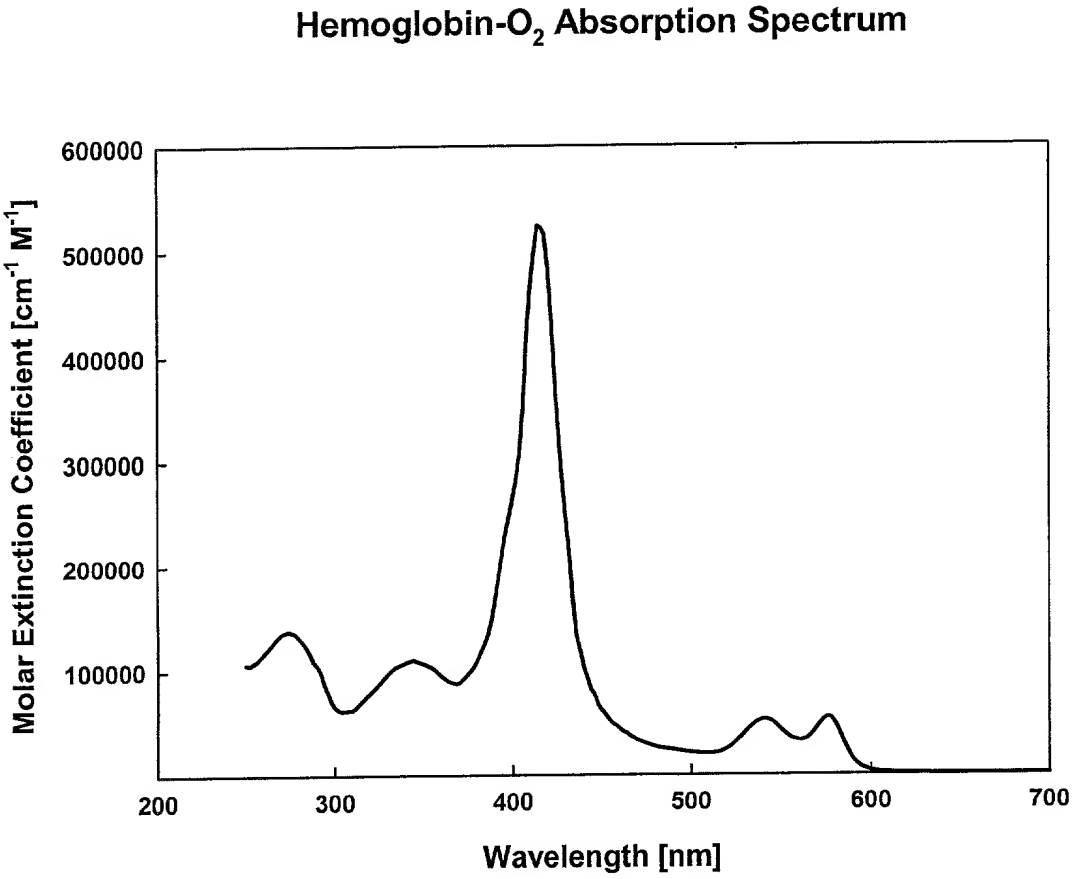

Hemoglobin-O_2 Absorption Spectrum
Molar Extinction Coefficient [cm^{-1} M^{-1}]
600000
500000
400000
300000
200000
100000
200
300
400
500
600
700
Wavelength [nm]

Fig. 31

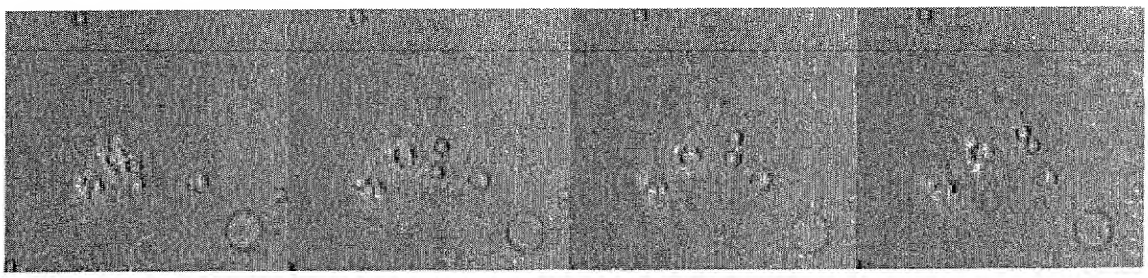


Fig. 32

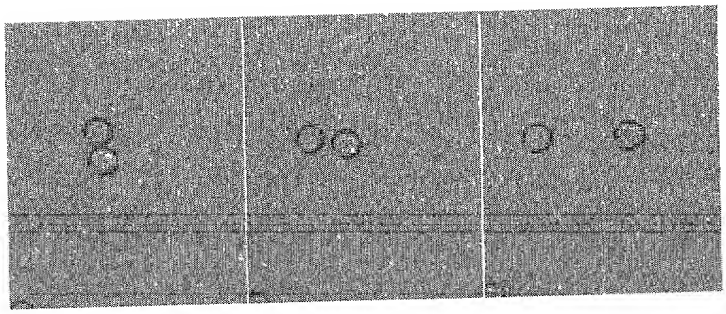


Fig. 33

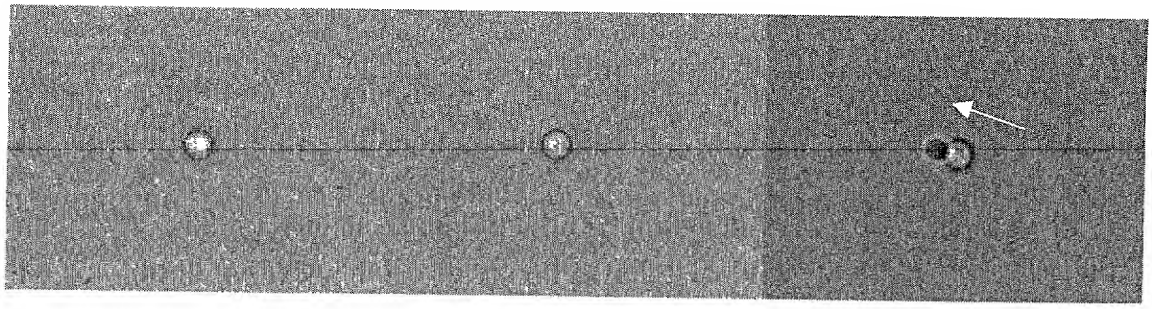


Fig. 34

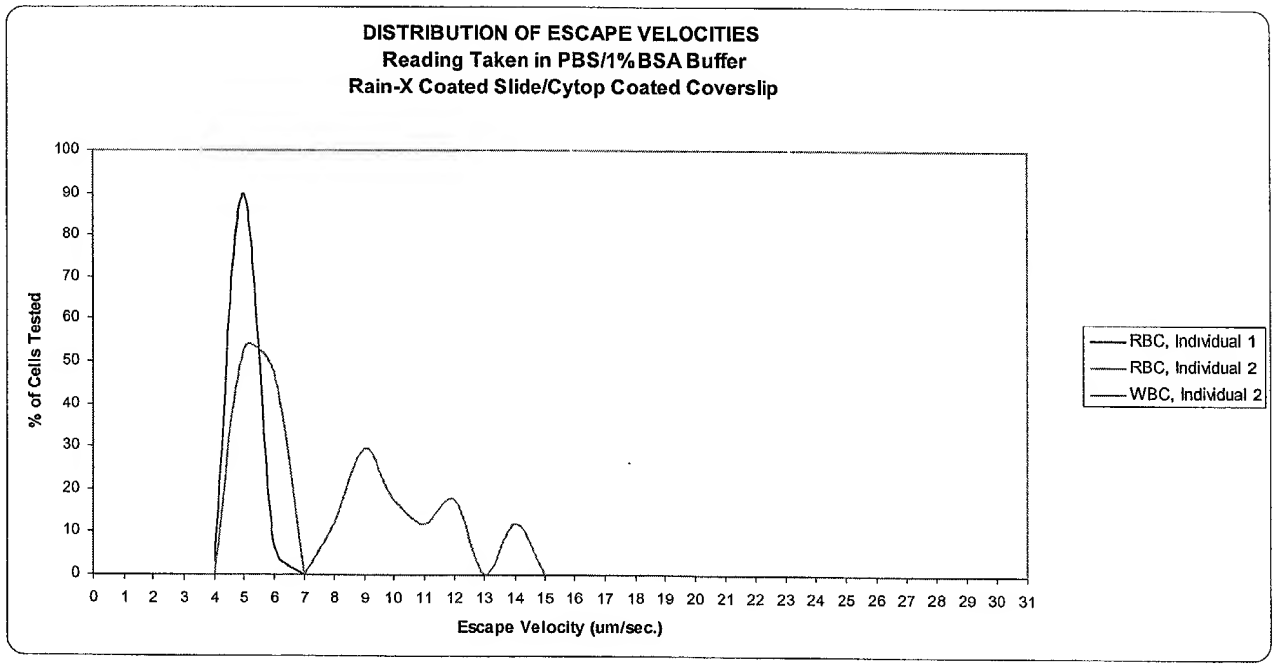


Fig. 35

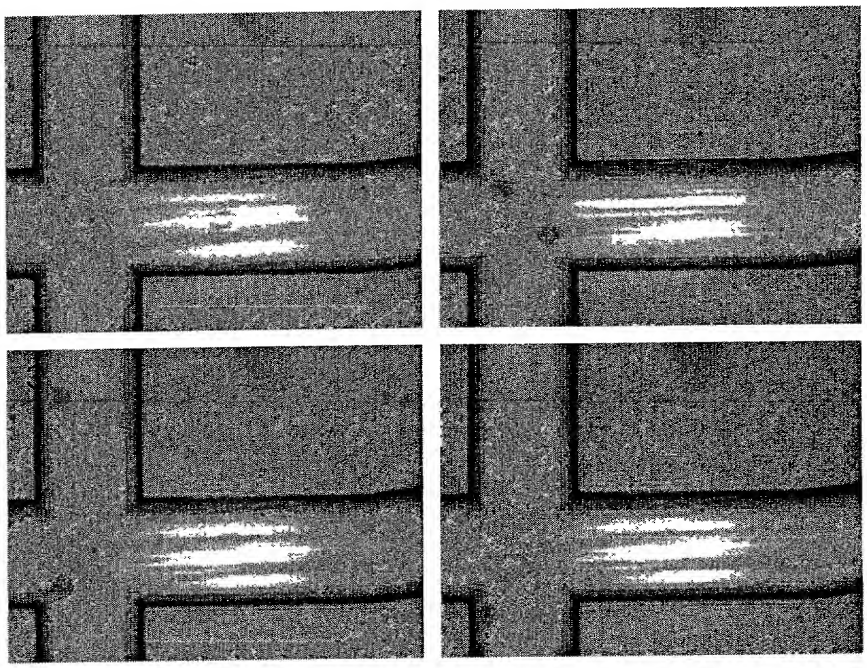


Fig. 36